

Sport Hunting

Decision Document Package

For

**Arthur R. Marshall Loxahatchee National
Wildlife Refuge**

Contents

EA

Environmental Assessment

2012 Sport Hunting Plan

For

ARTHUR R. MARSHALL LOXAHATCHEE
NATIONAL WILDLIFE REFUGE
PALM BEACH COUNTY, FLORIDA

For Further Information, Contact:
Refuge Manager
U. S. Fish and Wildlife Service
Arthur R. Marshall Loxahatchee National Wildlife Refuge
10216 Lee Road
Boynton Beach, FL 33437

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Chapter 1 Purpose and Need for Action

The National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd et seq.) provides authority for the U.S. Fish and Wildlife Service to manage national wildlife refuges across the country. The Act established wildlife conservation as the primary mission of the National Wildlife Refuge System. In accordance with the Act, refuges will be managed to fulfill the mission of the National Wildlife Refuge System, fulfill the individual purpose of each refuge, and maintain the biological integrity, diversity, and environmental health of the natural system.

While wildlife is first priority in refuge management, wildlife-dependent recreational uses or other uses may be allowed after they have been determined appropriate and compatible by the Refuge Manager. There are six priority wildlife-dependent public uses identified in the National Wildlife Refuge System Improvement Act: hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. These uses are dependent upon healthy fish and wildlife populations and are to receive enhanced consideration over other public uses in planning and management.

The purpose of this Environmental Assessment is to evaluate the environmental impact of adding an American alligator hunt into the recreational hunting program at the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge). Approximately 30,000 acres are currently open to waterfowl hunting in accordance with State and Refuge regulations. Waterfowl hunting regulations would remain the same as those currently in place at the Refuge. Further details are provided in the 2012 Sport Hunting Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The Refuge will continue to rely on coordination with the Fish and Wildlife Conservation Commission (FWC) to develop and manage hunting opportunities to the extent practicable in order to promote quality hunting programs.

The proposed action is to implement the 2012 Sport Hunting Plan to include an American alligator hunt at the Refuge.

Chapter 2 Alternatives Including the Proposed Action

This chapter discusses the alternatives considered for hunting on the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The alternatives are 1) no action – continue the current hunt program, and 2) proposed action - implement updates to the existing approved plan as referenced in the 2012 Sport Hunting Plan for the Refuge.

2.1 Alternative A: No Action - Current Management

Under this alternative, the current hunting program, which includes only waterfowl and coots, would continue as is. Thirty thousand acres on the southern end of the Refuge interior would remain open to hunting in accordance with State and Refuge regulations.

A total of 173 and 178 hunters used the Refuge during the 2010-2011 and 2011-2012 waterfowl seasons, respectively. During the 2010-2011 waterfowl season, a total of 640 ducks and coots were harvested from the Refuge. The harvest total for the 2011-2012 waterfowl season was 498 ducks. Waterfowl hunting on the Refuge is less active than surrounding hunt areas.

2.2 Alternative B: Proposed Action - 2012 Sport Hunting Plan for Arthur R. Marshall Loxahatchee National Wildlife Refuge

The proposed action would update the existing Waterfowl Hunt Plan and implement an American alligator hunt into the recreational hunt program at the Refuge. The hunt area for waterfowl and coot would remain at 30,000 acres identified as: south of latitude 26° 27.130 and north of mile markers 12 and 14 (marked in canal; not shown in map) (Figure 1). The alligator hunt would be conducted within the same hunt area and could be expanded to the remaining canal areas in the future if monitoring data supported the increase. All or parts of the Refuge may be closed to hunting at any time if necessary for public safety, to provide wildlife sanctuary, or for biological, habitat management, and administrative reasons to include hydrological conditions of the marsh or trends showing a decline in alligator populations.

Refer to the 2012 Sport Hunting Plan for the Arthur. R. Marshall National Wildlife Refuge for specific regulations and permitted hunt areas.

Chapter 3 Affected Environment

Prior to 1951, beginning with the Swampland Act of 1845 and later the 1907 Everglades Drainage Act, intensive drainage activities occurred in the Everglades to pave the way for agriculture and population expansion. Three Water Conservation Areas were constructed by the U.S. Army Corps of Engineers in the 1940's to meet the increase of water demands. Bounded by levees and connected only by a series of canals, these areas were placed under the jurisdiction of what is now the South Florida Water Management District (SFWMD), an agency of the State of Florida.

The Arthur R. Marshall Loxahatchee National Wildlife Refuge was established in 1951 under the authority of the Migratory Bird Conservation Act of 1929 and a 50 year license agreement between the State of Florida and the U.S. Fish and Wildlife Service (Service). The Refuge encompasses Water Conservation Area 1 which is referred to as the 'Refuge interior.' Water Conservation Area 1 is owned by the SFWMD, but managed by the Service as a national wildlife refuge. In 2002, the initial license agreement was revised and renewed for an additional 50 years. When the Refuge was established, it was known as the Loxahatchee National Wildlife Refuge. In 1986, the Refuge was renamed the Arthur R. Marshall Loxahatchee National Wildlife Refuge to honor former Service employee and noted South Florida conservationist, Arthur Raymond Marshall.

The current acreage of the Refuge interior is approximately 141,374 acres. In addition to the licensed lands, the Service owns 2,550 acres in fee title to the east and west of the

Refuge interior. This acreage is sub-divided into four management compartments (A, B, C, and D) and a 400-acre cypress swamp. In total, the Refuge currently manages 143,924 acres.

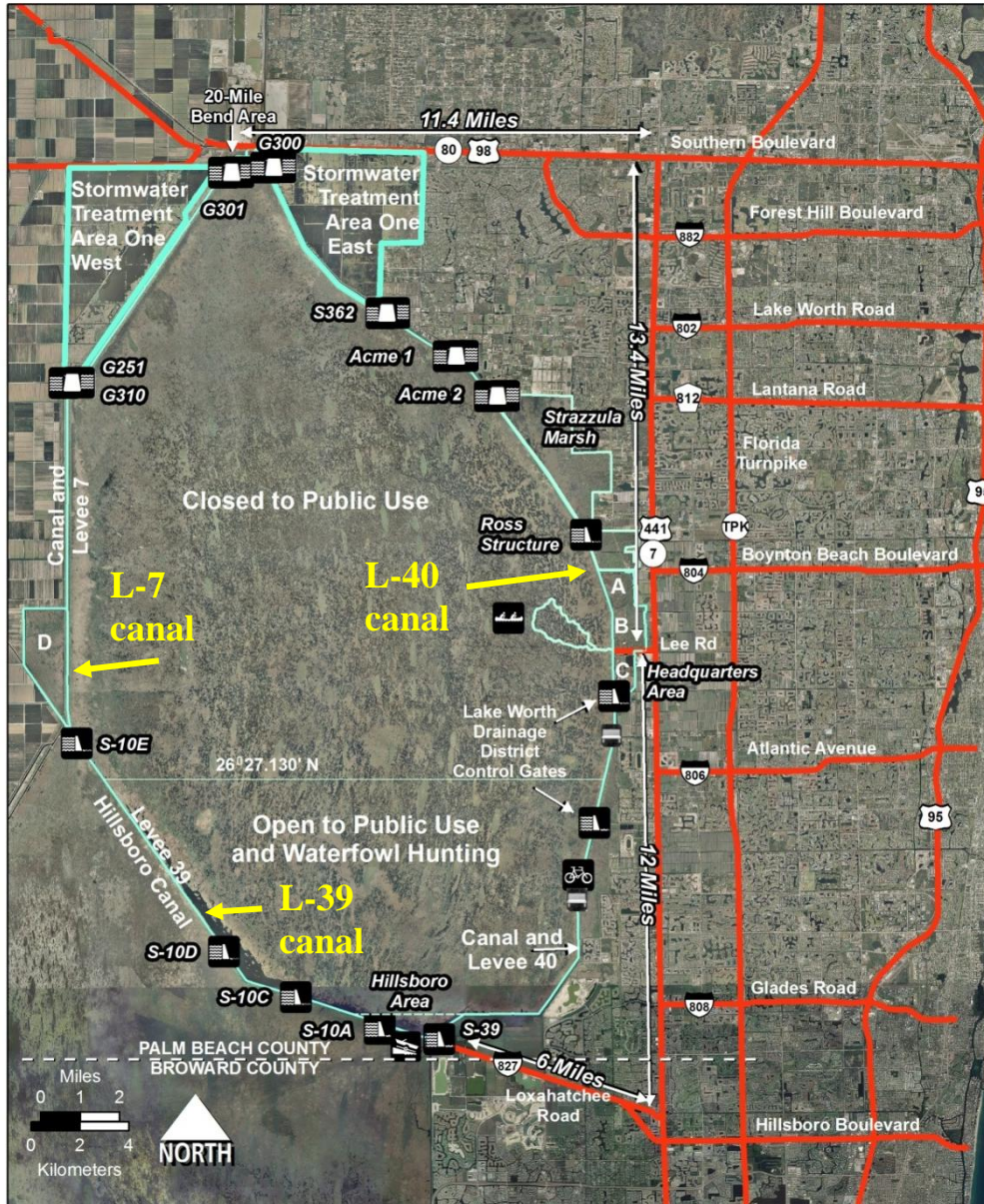


Figure 1. Arthur R. Marshall Loxahatchee National Wildlife Refuge. Hunt boundary is located at 26° 27.130' N (indicated by the horizontal light blue line).

The managed interior marsh of the Refuge is entirely impounded by three canals: the L-40, the L-39, and the L-7 (Figure 1). The L-40 canal is located on the eastern boundary

of the Refuge and is 29.2 miles long. The L-40 canal serves as a rim canal and is also part of a 57-mile levee/borrow canal system that runs along the entire perimeter of the Refuge marsh. The L-40 canal depth is approximately 12 feet with top width varying between 70-90 feet and the bottom width approximately 40 feet in the vicinity of the S-362 gate which is positioned in the northeast section of the Refuge adjacent to outflows from Stormwater Treatment Area 1 East (STA-1E). The sediment on the bottom of the L-40 canal is a combination of sand, silt, and clay. The vegetation found adjacent to the L-40 includes species such as Carolina willow (*Salix caroliniana*), cattails (*Typha* sp.), common reed (*Phragmites australis*), alligatorweed (*Alternanthera philoxeroides*), and scattered button bush (*Cephalanthus occidentalis*). There is evidence of common usage by wildlife, such as alligators, foraging wading birds, small mammals such as otters, grackles, gallinules, passerines, turtles, aquatic invertebrates, and small fish.

The L-39 is located along the southwestern boundary of the Refuge and is 12.9 miles long. The L-39 levee is adjacent to the L-40 canal on the south end. The L-7 is approximately 14.9 miles long and extends from the northern boundary of the L-39 to the northern boundary of the L-40 and completes the impoundment of the Refuge interior. The L-39 and L-7 are similar to the L-40 in depth and width as well as vegetation and wildlife usage, however, detailed information about the L-7 and L-39 are not readily available.

3.1 Physical Environment

The Refuge is the last remnant of the once vast northern Everglades ridge and slough landscape. It is located seven miles west of the city of Boynton Beach, in Palm Beach County, Florida. Palm Beach County is the largest county east of the Mississippi River in terms of land area and is the largest agriculture producing county in the east in terms of dollar value. Specifically, the Refuge is located west of U.S. Highway 441, south of U.S. Highway 80, and 15 miles west of the Atlantic Ocean.

The Refuge's climate is hot and humid most of the year and the winters are mild. In general, there are two seasons—wet and dry. The wet season occurs from late May to late October. The average wet season rainfall is approximately 60 inches. The dry season occurs from November to May.

The Everglades Agricultural Area, which includes large sugar cane and winter vegetable fields, sod farms, and cattle ranches, is located northwest of the Refuge. Rapidly expanding communities and quickly disappearing small farms are found east of the Refuge where nearly seven million people live from Ft. Pierce south to Miami. Water Conservation Areas 2 and 3 and Everglades National Park — the only other remaining portions of the Everglades freshwater marsh — are situated to the south and southwest of the Refuge.

Geologically, the Everglades are recent, having been formed only 5,000 years ago. The limestone bedrock of this once vast freshwater marsh is covered with a layer of peat up to 12 feet thick. Underlying the Refuge is a large aquifer which provides water to the

nearby coastal area. Land elevations vary from 17 feet msl at the northern tip of the Refuge to around 11 feet msl on the southern boundary. Enclosing the licensed area is a dike and associated borrow canal some 57 miles in length.

Water for purposes of flood control and consumptive use is intensely managed throughout the Everglades system by the U.S. Army Corp of Engineers (ACOE) and the SFWMD. Refuge water levels are managed according to an established water regulation schedule developed based on agricultural, urban, and ecological water needs of the local area (USFWS 2000). Refuge staff also has the opportunity to provide direct input for actions taken within the Refuge.

3.2 Vegetation

The Refuge provides a variety of habitat types including sloughs, wet prairies, sawgrass communities, tree islands, and cypress swamp.

Sloughs are the deepest natural marsh communities in the Everglades. The underlying sediment layer is composed of peat soils. Annual average slough depth is approximately one foot, but during the summer wet season slough depth may exceed three feet. Sloughs support numerous fish species, aquatic invertebrates, and other wildlife.

Wet prairies are shallower than sloughs and are characterized by short emergent plants. Wet prairies are the most prevalent vegetative community (approximately 50% land coverage) in most of the central and eastern portions of the Refuge interior and are generally found between sawgrass marshes and sloughs. This important vegetative community provides prey for wading birds and the endangered Everglade snail kite in the form of fish, aquatic invertebrates, and apple snails.

Sawgrass communities (approximately 25% Refuge land cover) are characterized by the saw-edged sedge that dominates this type of habitat. Sawgrass habitat often borders tree islands, separating them from wet prairies.

Tree islands vary in size from less than one acre to over 300 acres and are scattered over much of the Refuge's interior. Island elevation can be as much as three feet above the surrounding peat. Tree islands fall into two categories based on origin: strand and pop-up islands. Strand islands originate on strands of higher elevation, are elongated in shape, and oriented north-south along the pattern of historic flow direction. Pop-up islands are formed when submerged peat patches rise to the surface of the water, lodge in one place, and plants become established. The Refuge is characterized by thousands of tree islands that range from less than one acre to more than 300 acres. Approximately 20% of the Refuge interior is composed of tree islands.

Cypress swamp communities once stretched from the southeast corner of Lake Okeechobee to Ft. Lauderdale in Palm Beach and northern Broward Counties. The Refuge cypress swamp is a 400-acre swamp located on the eastern edge of the Refuge

boundary. This cypress swamp is the largest remaining remnant of a community on the east side of the Everglades.

3.3 Wildlife Resources

The Refuge provides important feeding, roosting, and nesting habitats for many birds, mammals, reptiles, amphibians, and fish species. In a given year, as many as 257 species of birds may use the diverse habitats found on the Refuge (Arthur. R. Marshall Loxahatchee NWR CCP, 2000). Of those, approximately 93 species are considered to be common or abundant during certain seasons (Arthur. R. Marshall Loxahatchee NWR CCP, 2000). A variety of duck species including mottled, ring-necked, fulvous whistling, wood, ruddy, blue and green-winged teal, lesser scaup, northern pintail, American widgeon, northern shoveler, hooded merganser, gadwall, and coot can be found on the Refuge during the fall and winter when water levels are appropriate and habitat is available (Arthur. R. Marshall Loxahatchee NWR CCP, 2000). The Fish and Wildlife Conservation Commission (FWC) conducted annual Mid-Winter Inventory surveys (flown each year during one week in early January) from 1980-2001 (see 2012 Sport Hunting Plan for more information). The Refuge was included in these surveys until budget cuts ended the State program. From 1980 to 2001, the general trends in waterfowl numbers appear to be lower with an average of 3,500 ducks observed, and a great deal of within-season and year-to-year variation in waterfowl numbers was observed (USFWS, Annual Narratives, 1980-2001). This decline can be partially explained by regional decreases in waterfowl populations (USFWS 2001). Florida lost approximately 260,000 acres of freshwater, emergent wetlands between 1985 and 1996 (FWC 2011). These habitat types in Florida are essential for the annual life cycle of waterfowl influencing both survival and subsequent reproduction (FWC 2011).

Twenty-three species of mammals commonly found in south Florida are known to occur on the Refuge including the Mexican free-tailed bat (*Tadarida basiliensis*), cotton mouse (*Peromyscus gossypinus*), river otter (*Lutra canadensis*), Eastern gray squirrel (*Sciurus carolinensis*), raccoon (*Procyon lotor*), bobcat (*Lynx rufus*), white-tailed deer (*Odocoileus virginianus*), round-tailed muskrat (*Neofiber alleni*), and marsh rabbit (*Sylvilagus palustris*) (Arthur. R. Marshall Loxahatchee NWR CCP, 2000).

Amphibians and reptiles are also well represented on the Refuge. Approximately ten species of turtles, eight species of lizards, 24 snake species, and American alligators (*Alligator mississippiensis*) are present on the Refuge (Arthur. R. Marshall Loxahatchee NWR CCP, 2000). Alligators are considered keystone species in the Everglades ecosystem because of their critical role in creating dry season refugia for the aquatic organisms that make up the prey base. In 1998, a series of regional American alligator surveys, which included the Refuge, were initiated by researchers at the University of Florida in support of Everglades restoration. Surveys in the Refuge were conducted in both the marsh and the L-40 perimeter canal. Results showed that there were greater alligator densities in both the Refuge marsh and canals than in any other area of the Greater Everglades USFWS (1999).

3.4 Threatened and Endangered Species

At least 63 plant or animal species listed by the State or Federal government as endangered, threatened, or species of special concern are known to occur on the Refuge, either currently or historically. These species include, but are not limited to: the wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis*), eastern indigo snake (*Drymarchon corais copuei*), Florida panther (*Felix concolor coryi*), bald eagle (*Haliaeetus leucocephalus*), Florida sandhill crane (*Grus canadensis pratensis*), snowy egret (*Egretta thula*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), and roseate spoonbill (*Ajaia ajaia*) (Arthur. R. Marshall Loxahatchee NWR CCP, 2000).

3.5 Fishery Resources

There are at least 46 species of temperate fresh water fish that occur regularly on the Refuge including mosquito fish, topminnow, largemouth bass, gar, and bowfin (Loftus and Kushlan 1987). Water level management greatly influences the range and survival of both invertebrates and fish on the Refuge. Water levels can dictate vegetation, habitat structure, and vulnerability of aquatic species to predation. Structurally simple sloughs and canals are dominated by bass and other predatory fish (Loftus and Kushlan 1987). Prawns and crayfish tend to occur more often in densely vegetated wet prairies than in sloughs (Lowe 1986). Small fish and large arthropods manage to avoid large fish in sloughs, but large arthropods feed on small fish in wet prairies and sawgrass stands. Prolonged high water with few droughts or drawdowns would likely result in more, larger largemouth bass, gar, and bowfin (Jordan 1996).

3.6 Cultural Resources

Prehistoric Background

Archaeologists suspect that prehistoric occupation did not occur on the Refuge because of little dry land on which to live. Even tree islands, which are thought to have formed within the last 1,000 years, would have been unsuitable for prehistoric occupation (Griffin et al., 1979). Three sites show evidence of the Glades tradition within close proximity to the Refuge (Griffin et al., 1979). The sites mentioned include the Cagles Hammock site, the Markham Park site (Williams and Mowers 1977), and the Peace Camp site (Mowers and Williams 1972).

Belle Glade (Okeechobee) Area

Griffin et al., (1979) have hypothesized that the Refuge may have been used by the Belle Glade People to travel east toward the Atlantic. Once there, the Belle Glade people could have traded with the groups occupying the area, or harvested the marine goods recovered at Fort Center (Griffin et al., 1979).

The closest Belle Glade site to the Refuge (according to Griffin et al., 1979) is the Boynton Mound Complex located within ½ mile of the eastern boundary.

Historic Period

By the time European explorers stepped foot on the Florida peninsula, there were five tribal groups associated with the east coast of Florida. These groups were the Timicua to the North, the Ais, the Guacata, the Jeaga, and the Tequesta to the south. All tribes were known to collect shellfish and other marine and aquatic resources which resulted in large shell and bone middens near the villages (Andrews and Andrews 1985). There is evidence that these middens/mounds were used as safe-havens of dry land when coastal flooding occurred (Andrews and Andrews 1985). Tribal groups most associated with the Refuge area were the Guacata, the Jeaga, and the Tequesta (Griffin et al., 1979). It appears that the Guacata occupied a territory in a band north of the Refuge which included the eastern shore of Lake Okeechobee and the coast near St. Lucie. Other groups, the Jeaga and perhaps even the Tequesta, would be located south of what is now the Refuge. By the 1800s, Native Americans from Georgia, Alabama, and South Carolina began filtering down into the Florida peninsula. These people became more cohesive through time as they fought together against the encroaching Europeans in the Second Seminole War of 1835-1842 (Neill 1956). The war's end could be nothing but a loss for the Seminoles as they were forcibly moved west. Those that chose to remain made their way into the Everglades inhabiting a land that the newer Americans did not seem to want (Griffin et al., 1979). With improved transportation, more non-Native American settlers began to move into the area. Small communities, most of which were short lived, sprang up near the Refuge. These consisted of Belle Glade c. 1913; Glade Crest c. 1914, on the Hillsboro Canal; Shawano c. 1924, on the Hillsboro Canal; 20 Mile Bend at the juncture of the Hillsboro and West Palm Beach Canals; Gladeview on Hillsboro Canal; and Loxahatchee c. 1913, on West Palm Beach Canal (Will 1964:180; Will 1968: 33) (Griffin et al., 1979). The new settlements, with associated road construction, managed to bypass the Refuge due to the inhospitable environment.

3.7 Socioeconomic

Palm Beach County is a county of extremes. Along the east coast lies a highly urbanized area, part of the South Florida urban system of some three million people. Urbanization extends westward through the county to the Refuge's eastern boundary. Around the Refuge, agriculture and low density urban dwellings exist. West of the Refuge's western border lies an extensive system of highly productive agricultural fields where sugar cane and other crops or sod are grown. The County and those that are proximal to Palm Beach including Broward and Martin are slowly losing their rural character and becoming urbanized. Broward County has already extended its urban fringe to the border of levees that surround the southern Everglades, similar to Dade County. Martin County to the north of Palm Beach is slowly developing into its western reaches. The population in Palm Beach County has grown 16.7% percent from 2000-2010 with a population of 1,131,184 to 1,320,134, respectively. Median and per capita incomes for Palm Beach County from 2006- 2010, were much higher than the State averages (\$53,242 and \$33,610, respectively).

Traditional forms of outdoor recreation in the local four county region (Palm Beach, Martin, St. Lucie, and Indian River) include hunting, fishing, and wildlife observation. Hunting and fishing are a traditional form of outdoor recreation for many people in South Florida. Many of the hunters and fishermen who utilize the Refuge come from the local area. During the latest National Survey of Fishing, Hunting and Wildlife-Associated Recreation held in 2006, it was indicated that in Florida, there were 5.9 million residents and nonresidents participating in fishing, hunting, and watching wildlife.

Chapter 4 Environmental Consequences

This chapter describes the foreseeable environmental consequences of implementing the two management alternatives in Chapter 2. When detailed information is available, a scientific and analytic comparison between alternatives and their anticipated consequences is presented, which is described as “impacts” or “effects.” When detailed information is not available, those comparisons are based on the professional judgment and experience of Refuge staff and Service and State biologists.

4.1 Effects Common to all Alternatives

4.1.1 Environmental Justice

Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” was signed by President Bill Clinton on February 11, 1994, to focus Federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority and low-income communities access to public information and participation in matters relating to human health or the environment. This assessment has not identified any adverse or beneficial effects for either alternative unique to minority or low-income populations in the affected area. Neither alternative will disproportionately place any adverse environmental, economic, social, nor health impacts on minority or low-income populations.

4.1.2 Public Health and Safety

Each alternative would have similar minimal to negligible effects on human health and safety.

4.1.3 Refuge Physical Environment

Impacts of each alternative on the Refuge physical environment would be similarly minimal to negligible for each alternative. Some disturbance to surface soils, topography, and vegetation would occur in areas selected for hunting; however, effects would be minimal. The Refuge controls access to the Refuge interior by limiting public access to only the current hunt boundary with only limited approved water craft in order to minimize habitat degradation as a result of visitor access.

Negligible impacts to the natural hydrology of the Refuge are also expected. The Refuge expects impacts to air and water quality to be minimal and result only from Refuge visitors' boat emissions. Existing State water quality criteria and use classifications are adequate to achieve desired on-Refuge conditions; thus, implementation of the proposed action would not impact adjacent landowners or users beyond the constraints already implemented under existing State standards and laws.

Impacts associated with solitude are expected to be minimal given time and space management techniques used to avoid conflicts among user groups, such as seasonal access and area closures.

4.1.4 Cultural Resources

Under each alternative, hunting, regardless of method or species targeted, is a consumptive activity that does not pose any threat to historic properties on and/or near the Refuge.

4.1.5 Facilities

Maintenance or improvement of existing facilities (i.e. parking areas, trails, and boat ramps) will cause minimal short term impacts to localized soils and waters and may cause some wildlife disturbances and damage to vegetation.

4.2 Summary of Effects

4.2.1 Impacts to Habitat

No Action Alternative

Under this alternative the existing hunt plan (approved in 1982) would remain the same for waterfowl and coot hunting. Access via existing marsh trails would be maintained at current levels.

Proposed Action Alternative

The proposed alternative allows for a public American alligator hunt in addition to waterfowl hunting within the existing hunt boundary (30,000 acres).

It is anticipated that revising the hunt plan to include American alligators would offer more opportunity to the hunting public. Impacts to vegetation and habitat should be

minor due to the limited type of approved vessel access and the typically preferred hunting locations. Refuge regulation currently permits the use of water cooled outboard motor boats, canoes, and kayaks only. Although the entire hunt area would be open for alligator hunting, it is expected that the majority of alligator hunting will be conducted in the perimeter canals. As a result, impacts from increased traffic on existing marsh trails or creation of new trails are expected to be minimal to negligible. Current restrictions on hunting from the Refuge levee system are expected to be maintained in the foreseeable future.

4.2.2 Impacts to Hunted Wildlife

No Action Alternative

The implementation of the proposed alligator hunt would not occur, therefore, no alligators would be impacted. Harvest numbers for waterfowl and coot would continue to be established through annual frameworks prescribed by the Service and regulated by the State. Therefore, impacts to hunted wildlife would not be significantly different from the current impacts.

Proposed Action Alternative

The total number of waterfowl harvested is not expected to increase significantly, if at all, under the proposed action alternative. The harvest numbers and species are determined by annual waterfowl trends and population surveys (see Section 4.3.1.1 for more information).

Implementation of the proposed plan is expected to result in mortality of individual alligators as the hunt program at the Refuge would change to include American alligators. However, the overall alligator population at the Refuge is not expected to be significantly impacted as a result of the proposed action because of the large number of alligators in the perimeter canals and the sustainable harvest quota that will be implemented. Although there is significant variability in the data as a result of detectability, methodology, and water level issues, alligator densities have not significantly decreased since 2003 (see 2012 Sport Hunting Plan (Section IV, E) and Section 4.3.1.2 below for more information). Therefore, it is expected that the Refuge could sustain a limited alligator harvest without negatively impacting alligator populations.

A harvest quota will be established and evaluated each year based on monitoring surveys in the perimeter canals (see Section 4.3.1.2 for more information). It is important to note that the goal for the alligator hunt is to provide a quality hunt and expand public use opportunities with no or minimal impact to the alligator population as well as continue to provide wildlife observation and wildlife refuge for the same.

4.2.3 Impacts to Non-hunted Wildlife

No Action Alternative

With the existing waterfowl hunt being the only recreational hunt opportunity currently available at the Refuge, no additional mortality or disturbance to any non-hunted wildlife is expected as hunting pressure and public use would remain at current levels.

Proposed Action Alternative

The proposed action would add an alligator harvest to the existing recreational hunt program at the Refuge. While hunting potentially causes some incidental disturbance to non-hunted species, such as roosting non-game bird species and small mammals and/or reptiles, Refuge regulations are expected to mitigate possible disturbance by hunters to non-hunted wildlife. Vessels are restricted to water cooled outboard motor boats, canoes, and kayaks, and the harassment or taking of any wildlife other than the game species legal for the season is not permitted.

Disturbance to the daily activities, such as feeding and resting, of birds and alligators might occur, but would be transitory as hunters traverse habitat. Disturbance to birds by hunters would probably be commensurate with that caused by public users in activities such as wildlife observation, hiking, and boating.

Small mammals, including marsh rabbits, are less active during the winter (waterfowl season) and nights (alligator season) when active hunting occurs, and habitat for marsh rabbit is not optimal in the proposed area. Hunters may encounter reptiles and amphibians during the hunting season, but these encounters would occur during the non-breeding season and at a time of relatively high water compared to spring and early summer levels. Therefore, Refuge regulations and the expectation that hunters will preferentially hunt alligators in open canal areas minimizes incidental disturbance to non-hunted wildlife such as small mammals, non-alligator reptiles, and/or roosting birds.

4.2.4 Impacts to Endangered and Threatened Species

No Action Alternative

The existing plan (1982) includes preferred habitat for endangered species such as Everglade snail kites and wood storks. Therefore, the possibility exists for limited incidental disturbance to endangered species as a result of the waterfowl hunt currently in place. However, additional mortality or impacts to threatened and endangered species under this alternative are not expected because hunting pressure would remain at current levels as additional species would not be added to the recreational hunting program.

Proposed Action Alternative

Disturbance impacts to threatened and endangered species may increase slightly due to increased use; however, significant disturbance would be unlikely. Nesting populations of Everglade snail kite, wood storks, and other listed species would not be significantly disturbed as a result of the proposed action alternative since both the alligator hunt and waterfowl season will not be conducted during any threatened or endangered nesting season.

4.2.5 Impacts to Refuge Facilities (roads, trails, parking lots, levees)

No Action Alternative

Costs associated with the hunting program in the form of boat ramp and marsh trail maintenance, instructional sign needs, and law enforcement would remain unchanged. Ramp maintenance, signage, and law enforcement to enforce Refuge regulations would still occur.

Proposed Action Alternative

Costs associated with the hunting program in the form of boat ramp and marsh trail maintenance, instructional sign needs, and law enforcement would increase due to increased staff time to prepare for an additional hunt. Ramp maintenance, signage, and law enforcement to enforce Refuge regulations would still occur.

4.2.6 Impacts to Wildlife Dependent Recreation

No Action Alternative

Under this alternative the existing hunt plan would remain the same for waterfowl and coot hunting.

Proposed Action Alternative

As public use levels expand over time, unanticipated conflicts between user groups may occur. Experience has proven that time and space zoning (e.g., establishment of separate use areas, use periods, and restrictions on the number of users) is an effective tool in eliminating conflicts between user groups. Conflicts between hunters and non-consumptive users might occur, but would be mitigated by time (non-hunting season) and space zoning. The Refuge would focus non-consumptive use (mainly bird watching and other wildlife viewing) in the areas that are closed to hunting. There will also be a “no hunting” area established east of the L-40 levee where the headquarters and visitor center building, Refuge residences, shop compound, other associated building facilities, hiking trails, and observation tower are located. Implementation of this “no hunting” zone would facilitate all five of the remaining Priority Public Uses as defined in the Refuge Improvement Act of 1997.

The public would be allowed to harvest a renewable resource, and the Refuge would be promoting a wildlife-oriented recreational opportunity that is compatible with the purpose for which the Refuge was established. The public would have an increased awareness of the Arthur R. Marshall Loxahatchee National Wildlife Refuge and the National Wildlife Refuge System, and public demand for more hunting would be met. Waterfowl and alligator hunting are both very popular activities in Florida. Opening designated areas of the Refuge to alligator hunting, in addition to waterfowl hunting, would provide the hunting public with another opportunity. Hunting will allow for the consumptive use of a renewable resource without adversely impacting wildlife populations, habitat, or other

Refuge objectives. Waterfowl and alligators will be harvested at levels sufficient to provide a quality, recreational experience while maintaining healthy, viable wildlife populations. This alternative would allow the public the opportunity to experience a wildlife-dependent recreation, instill an appreciation for and understanding of wildlife within the natural world and environment, and promote a land ethic and environmental awareness.

Impacts associated with solitude are expected to be minimal given time and space zone management techniques, such as seasonal access and area closures, used to avoid conflicts among user groups.

4.3 Cumulative Impacts Analysis

4.3.1 Anticipated Direct and Indirect Impacts of Proposed Action on Wildlife Species

4.3.1.1 Migratory Birds

The U.S. Fish and Wildlife Service annually prescribes frameworks, or outer limits, for dates and times when migratory bird hunting may occur and the number of birds that may be taken and possessed for each species. These frameworks are necessary to allow State selections of season and limits for recreation and sustenance; aid Federal, State, and Tribal governments in the management of migratory game birds; and permit harvests at levels compatible with population status and habitat conditions. Because the Migratory Bird Treaty Act stipulates that all hunting seasons for migratory game birds are closed unless specifically opened by the Secretary of the Interior, the Service annually promulgates regulations (50 CFR Part 20) establishing the frameworks from which States may select season dates, bag limits, shooting hours, and other options for the each migratory bird hunting season. The frameworks are essentially permissive in that hunting of migratory birds would not be permitted without them. Thus, in effect, Federal annual regulations both allow and limit the hunting of migratory birds.

Migratory game birds are those bird species so designated in conventions between the United States and several foreign nations for the protection and management of these birds. Under the Migratory Bird Treaty Act (16 U.S.C. 703-712), the Secretary of the Interior is authorized to determine when "hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any ... bird, or any part, nest, or egg" of migratory game birds can take place, and to adopt regulations for this purpose. These regulations are written after giving due regard to "the zones of temperature and to the distribution, abundance, economic value, breeding habits, and times and lines of migratory flight of such birds, and are updated annually (16 U.S.C. 704(a)). This responsibility has been delegated to the U.S. Fish and Wildlife Service as the lead federal agency for managing and conserving migratory birds in the United States. Acknowledging regional differences in hunting conditions, the Service has administratively divided the nation into four Flyways for the primary purpose of managing migratory game birds. Each Flyway (Atlantic, Mississippi, Central, and Pacific) has a Flyway Council, a formal organization generally composed of one member

from each State and Province in that Flyway. Arthur R. Marshall Loxahatchee National Wildlife Refuge is within the extreme southern reaches of the Atlantic Flyway.

The process for adopting migratory game bird hunting regulations, located in 50 CFR Part 20, is constrained by three primary factors. Legal and administrative considerations dictate how long the rule making process will last. Most importantly, however, the biological cycle of migratory game birds controls the timing of data gathering activities and thus the dates on which these results are available for consideration and deliberation. The process of adopting migratory game bird hunting regulations includes two separate regulations development schedules, based on "early" and "late" hunting season regulations. Early hunting seasons pertain to all migratory game bird species in Alaska, Hawaii, Puerto Rico, and the Virgin Islands; migratory game birds other than waterfowl (e.g. dove, woodcock, etc.); and special early waterfowl seasons, such as teal or resident Canada geese. Early hunting seasons generally begin prior to October 1. Late hunting seasons generally start on or after October 1 and include most waterfowl seasons not already established. There are basically no differences in the processes for establishing either early or late hunting seasons. For each cycle, Service biologists and others gather, analyze, and interpret biological survey data and provide this information to all those involved in the process through a series of published status reports and presentations to Flyway Councils and other interested parties (USFWS 2011).

Because the Service is required to take abundance of migratory birds and other factors into consideration, the Service undertakes a number of surveys throughout the year in conjunction with the Canadian Wildlife Service, State and Provincial wildlife management agencies, and others. To determine the appropriate frameworks for each species, the Service considers factors such as population size and trend, geographical distribution, annual breeding effort, the condition of breeding and wintering habitat, the number of hunters, and the anticipated harvest. After frameworks are established for season lengths, bag limits, and areas for migratory game bird hunting, migratory game bird management becomes a cooperative effort of State and Federal Governments. After Service establishment of final frameworks for hunting seasons, the States may select season dates, bag limits, and other regulatory options for the hunting seasons. States may always be more conservative in their selections than the Federal frameworks, but never more liberal. Season dates and bag limits for national wildlife refuges open to hunting are never longer or larger than the State regulations. In fact, based upon the findings of an environmental assessment developed when a national wildlife refuge opens a new hunting activity, season dates and bag limits may be more restrictive than the State allows. At the Arthur R. Marshall National Wildlife Refuge, the waterfowl and coot season length is consistent with State season limits.

NEPA considerations by the Service for hunted migratory game bird species are addressed by the programmatic document, "Final Supplemental Environmental Impact Statement: Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds (FSES 88-14)," filed with the Environmental Protection Agency on June 9, 1988. The Service published Notice of Availability in the Federal Register on June 16, 1988 (53 FR 22582), and the Record of Decision on August 18, 1988 (53 FR 31341). Annual

NEPA considerations for waterfowl hunting frameworks are covered under a separate Environmental Assessment, “Duck Hunting Regulations for 2006-07,” and an August 24, 2006, Finding of No Significant Impact. Further, in a notice published in the September 8, 2005, Federal Register (70 FR 53376); the Service announced its intent to develop a new Supplemental Environmental Impact Statement for the migratory bird hunting program. Public scoping meetings were held in the spring of 2006, as announced in a March 9, 2006, Federal Register notice (71 FR 12216). More information may be obtained from: Chief, Division of Migratory Bird Management, U.S. Fish and Wildlife Service, Department of the Interior, MS MBSP-4107-ARLSQ, 1849 C Street, NWR, Washington, DC 20240.

4.3.1.2 Alligators

Monitoring data suggests that the Refuge could support a limited alligator hunt. Therefore, in the interest of incorporating as many public use opportunities as ecologically and economically possible, an alligator hunt for recreational purposes has been evaluated.

Alligator populations in the Refuge marsh and canals have been monitored by various researchers for many years, including monitoring as part of the Comprehensive Everglades Restoration Monitoring and Assessment (see 2012 Sport Hunting Plan, Section IV, E for more information). Marsh surveys indicate the Refuge is the only surveyed area that consistently meets Comprehensive Everglades Restoration Plan (CERP) alligator abundance targets (CERP, 2009). Because it's expected that hunters will be harvesting alligators from primarily the canals, only canal populations are discussed further.

Alligator population data within the Refuge canals have been collected using the same standard protocols that the FWC alligator management program (FWC, 2011) uses in monitoring their alligator populations on State lands for their managed hunts. FWC has been using monitoring methods which include night-light surveys along established routes for many years (see Appendix B for more information on night-light survey methods).

In addition to these standard protocols, alligator population data was also collected using protocols established in the Comprehensive Everglades Restoration Monitoring and Assessment Plan (Mazzotti et al., 2009) for region-wide surveys. Data collected and included in population analyses was gathered by independent researchers (L. Brandt and F. Mazzotti; USFWS; and UF) during spring surveys conducted between the months of February and April from 1999 through 2012 in the L-39 and L-40 canals. All available replicates were included in the analyses. The Refuge was divided into 2 units for the sake of these analyses. Twenty-one kilometers of canal along the L-39 were surveyed as Unit 4151, and ten kilometers of canal along the L-40 were surveyed as Unit 4152 (Figure 2).

As indicated by standard methodology, count data from night-light surveys were collected in known 0.25-m sizes for total length (e.g., 1.75-2.0 m), estimated size

groupings for total length (e.g., ≥ 1.75 m), and unknown sized alligators (e.g., an eye shine was observed from a distance, but no indication of size otherwise). For the purposes of analyzing trends, size estimate data were converted to English units (ft). Water stage at the 1-8C gauge was obtained from the USGS website for the each survey.

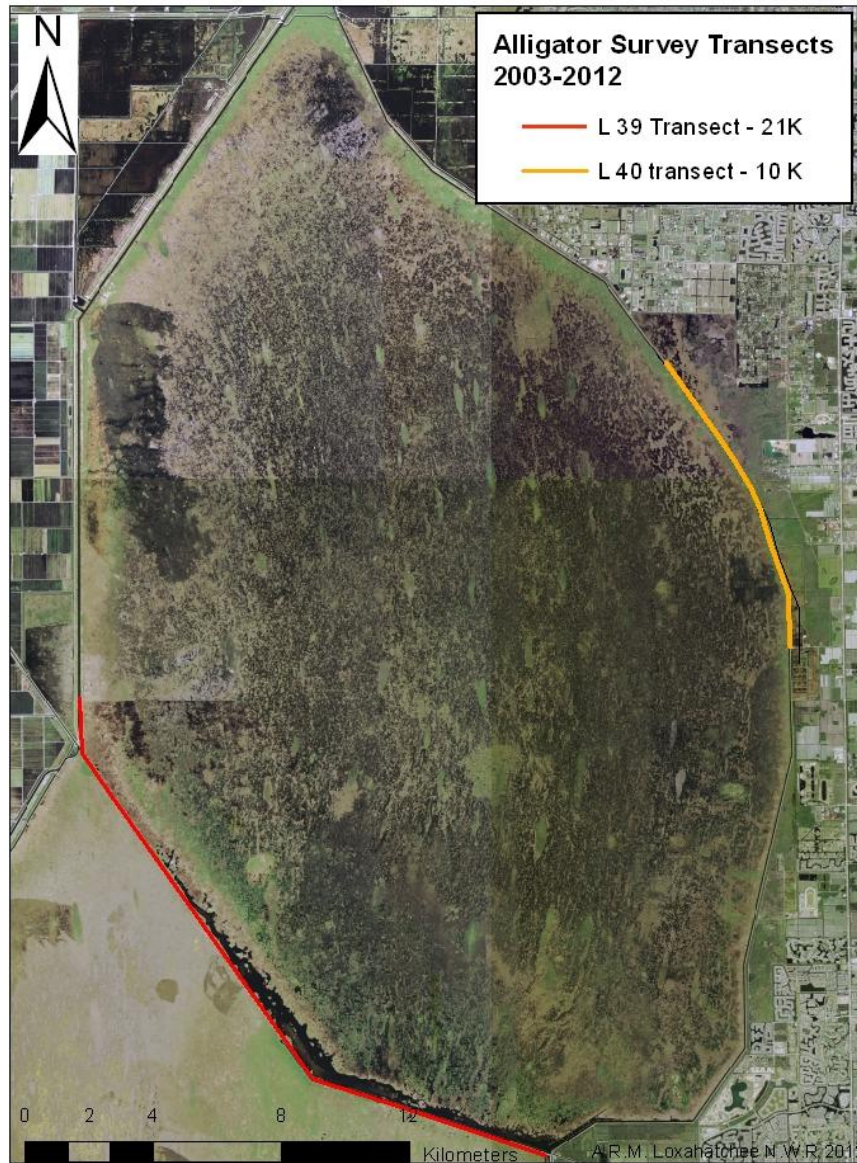


Figure 2. Location of night-light survey transects conducted in the A.R.M. Loxahatchee NWR between the months of February and April from 1999 through 2012. The length of the L-39 and L-40 canal transects are 21 and 10 km, respectively.

Surveys for determining alligator hunt quotas are generally conducted in the spring (February – April); with 1 – 2 replicate surveys per year. A modified algorithm for interval-censored data was used to allocate survey counts of alligators that were placed into general size categories or were of unknown size into 1-ft size intervals for each replicate-unit-year (see Appendix C). This was then used to estimate the number of alligators counted in the 7 size categories to be analyzed (see below).

Seven different size categories of alligators were examined when assessing alligator population abundance, including juveniles (1-4 ft.), sub-adults (3-6 ft.), harvestable (≥ 4 ft.), adults (≥ 6 ft.), breeders (6-9 ft.), and bulls (≥ 9 ft.). Total population trends (1-14 ft.) provide information on the status of alligators of all sizes within each alligator management unit (AMU). Juvenile population trends provide information that is useful for assessing recruitment of the youngest size classes into the population. Sub-adult population trends provide information regarding the population's potential recruitment pool for breeding adults. The harvestable size class represents the population segment most likely to be harvested as a result of the economic benefits provided by their hide and meat value. Adult population trends provide information that is useful for assessing breeding-sized alligators. The adult trends and population estimates are also used to establish harvest quotas on AMUs. Breeders represent those size classes that encompass adult breeding females. Although this size category is not exclusive to females, monitoring its trends is a tool for evaluating the status of the breeding female segment of the population. Bull population trends are monitored because they are often targeted by trophy hunters, and because the public values large alligators for the aesthetic appeal.

Data collected from surveys was analyzed using six generalized additive models (GAMs) containing the following linear and nonlinear predictors: (1) non-linear year effect; (2) non-linear year and non-linear water level effects; (3) non-linear year and linear water level effects; (4) linear year effect; (5) linear year and linear water level effects; (6) linear year and non-linear water level effects. Count data were log-transformed (natural logarithms) prior to conducting the GAM analyses. Estimated numbers of alligators were obtained by adjusting the estimated endpoint for alligators counted (obtained from the GAM analyses) by a detection rate factor that accounts for the proportion of alligators not observed during the surveys. Back-transformed estimated (predicted) numbers of alligators with 70% confidence intervals were plotted for all 6 of the models. The back-transformed population estimates are then compared to the first year surveyed, before any harvesting took place (noted as “preharvest population”). An Akaike Information Criterion (AIC) was used to select the simplest model that does the best job of fitting trend data. The model with the highest AIC was used to assess populations per standard protocol.

Once annual population abundances are estimated for the period of record, the standard criteria below were used to determine hunt quotas based on alligator population abundance for the target size class, which was considered 6–14 ft. because harvest will be limited to animals greater than 5 ft. It should be noted that although data from the L-40 and L-39 were used to assess populations, only data from the L-39 survey was used in

determination of the 2012 annual quota because 1) the L-39 transect is in closest proximity to the actual area where hunting will be permitted, and 2) the L-40 transect is technically outside of the permitted hunt boundary. Data considered in the FWC method for harvest quota determination was collected between the months of February and April in years 2003 through 2012.

There are four action zones used by FWC to determine annual quotas (see Figure 3):

- (1) A "red" zone (evoking a "stop" response) that depicts that area of a population model graph that is below 50% of the preharvest population estimate. When the current population estimate is within this zone, a zero quota will be recommended.
- (2) A "yellow" zone (evoking a "caution" response) that depicts that area of a population model graph that is between 50 and 75% of the preharvest population estimate. When the current population estimate is within this zone, a quota expected to achieve a 3% harvest will be recommended.
- (3) A "green" zone (evoking a "go" response) that depicts that area of a population model graph that is between 75 and 125% of the preharvest population estimate. When the current population estimate is within this zone, a quota expected to achieve a 6% harvest will be recommended.
- (4) A "white with black hash marks" zone (evoking an "out of bounds" response) that depicts that area of a population model graph that is above 125% of the preharvest population estimate. When the current population estimate is within this zone, a quota expected to achieve a 12% harvest will be recommended. If after applying this rate for three years the population estimate remains in this zone, the rate will be elevated to 15%.

NOTE: A greater than 25 percent change above or below the preharvest population estimate will be declared only if bootstrap P-values for tests on the predicted percent change are less than 0.15.

Analyses for both the L-39 and L-40 transects indicate that populations in nearly all size groups were stable over the period of record. The one exception is the sub-adult size category (3–6 ft.) in the L-40, in which the data suggests there has been a significant decline from pre-harvest levels (1999) by established method standards ($p < 0.15$). However, the population as a whole (1–14 ft.) appears stable ($p > 0.15$). It is not expected that the proposed alligator hunt will further impact the sub-adult size category as hunters will be restricted to harvesting animals greater than 5 ft. in length and only limited access to the L-40 canal is allowed for alligator hunting.

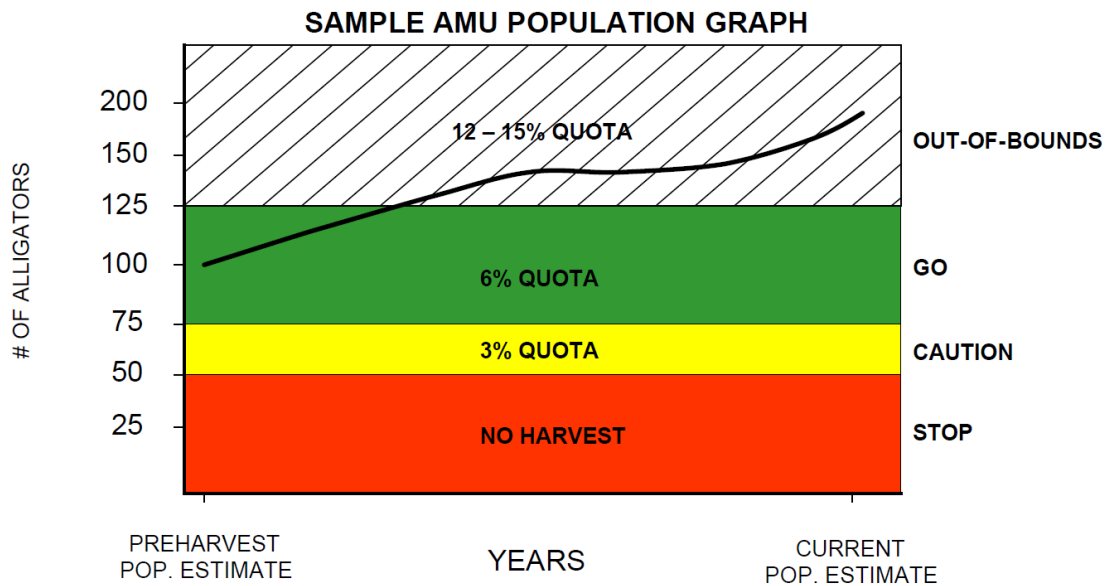


Figure 3. Four action zones used by FWC to determine annual quotas for each AMU. Percentages represent the proportion of the estimated alligator population that will be available for harvest. Graph provided by FWC.

The FWC method described above will be used, in part, to establish annual quotas for alligator hunting in the Refuge. These methods are used to establish quotas for hunting in other AMUs, including those AMUs in close proximity to the Refuge, such as Stormwater Treatment Area 1 West (STA-1W) and Water Conservation Area 2 (WCA-2). However, it is important to note that the goal for the alligator hunt in the Refuge is to provide a high quality hunt and set annual harvest quotas that are in line with multiple compatible uses, such as wildlife observation and providing wildlife refuge, rather than the maximum sustainable harvest. Therefore, final annual quotas will be at the discretion of Refuge management, who will consider Refuge priorities and goals and cumulative effects in addition to quotas determined by the FWC method described above. The conservative harvest quota proposed for 2012 is approximately 3% of the estimated target population (6-14') (22 alligators), rather than 6% as recommended by the method described above.

In 2007, the SFWMD initiated an alligator hunt in a portion of STA-1W, a manmade filter marsh adjacent to the northwestern portion of the Refuge that was designed to improve the quality of water prior to being delivered to the Refuge. A second hunt area within STA-1W was opened in 2009 (STA-1W South). Alligators are very numerous in STA-1W. A 2007 survey indicated a population estimate of 11,938 alligators over six feet (per comm. with Harry Dutton, FWC, 2011) due to the large number of canals, levees, and shallow areas providing favorable foraging and basking habitat, although nesting has not been observed. Due to the proximity to the Refuge and lack of nesting

within STA-1W, it is likely that the majority of the alligators in the STA migrate from the Refuge. There is also a recreational alligator hunt in WCA-2 to the south. While the annual harvest quota in WCA-2 is similar to the proposed 2012 Refuge harvest quota, the harvest quota for STA-1W is significantly greater than the proposed harvest quota for the Refuge (Tables 1 and 2). Due to the close proximity of the Refuge to these areas, and the strong possibility that alligators move between these adjacent areas, the Refuge will need to ensure through monitoring that negative cumulative impacts to alligator populations do not occur.

Table 1. Stormwater Treatment Area 1 West (STA1-W) Alligator Harvest Per Year.

Harvest Year	Number of Alligators Harvested STA-1W North (Harvest quota max = 200)	Number of Alligators Harvested STA-W South (Harvest quota max = 100)
2007	162	-
2008	164	-
2009	166	88
2010	158	72

Available at: http://myfwc.com/media/1357388/Alligator_Annual_Summaries.pdf.

Table 2. Water Conservation Area 2 (WCA-2) Alligator Harvest Per Year.

Harvest Year	Number of Alligators Harvested WCA2 (Harvest quota max = 22)
2003	20
2004	15
2005	17
2006	21
2007	15
2008	18
2009	10
2010	18

Available at: http://myfwc.com/media/1357388/Alligator_Annual_Summaries.pdf.

FWC will conduct spring transect surveys within the Refuge hunt boundary to determine annual quotas in accordance with their standard procedures. Harvest quotas recommended by FWC as a result of this method will be taken into consideration by Refuge management when setting the final harvest quota. Refuge staff will conduct additional transects in the spring and/or fall to supplement surveys conducted by FWC to monitor for cumulative effects and to assess if other areas (e.g., canals north of the hunt boundary) can be opened to recreational alligator hunting.

4.3.1.3 Non-hunted Wildlife

Non-hunted wildlife would include non-hunted migratory birds such as songbirds, wading birds, raptors, and woodpeckers; small mammals such as marsh rabbits, voles, moles, mice, shrews, and bats; reptiles and amphibians such as snakes, skinks, turtles, lizards, salamanders, frogs and toads; and invertebrates such as butterflies, moths, other insects and spiders. Except for migratory birds and some species of migratory bats, butterflies, and moths, these species have very limited home ranges, and hunting could not affect their populations regionally; thus, only local effects will be discussed.

Disturbance to non-hunted migratory birds could have regional, local, and flyway effects if the hunt season was proposed during a different time of year; however, the proposed action does not coincide with nesting season. Therefore, the cumulative effects of disturbance to non-hunted migratory birds under the proposed action are expected to be negligible. It is also anticipated long term impacts to reproduction would not be likely. Disturbance to the daily wintering activities, such as feeding and resting of birds, might occur. Disturbance to birds by hunters would probably be commensurate with that caused by non-consumptive users.

The cumulative effects of disturbance to non-hunted resident wildlife under the proposed action are expected to be negligible and disturbance would be unlikely for the following reasons. Small mammals, including marsh rabbits, are active year round in the marsh, but activity is limited to foraging and resting behavior. The hunt season does not coincide with the mating season of marsh rabbits, limiting disturbance. In addition, access is severely limited to open water sloughs and deep water settings in the south Refuge and do not support optimal habitat for small mammals. These qualities make hunter interactions with small mammals very rare. Hunters may encounter reptiles and amphibians during the hunting season, but these encounters would occur during the non-breeding season and at a time of relatively high water compared to spring and early summer levels. Water conditions and hunter interactions should not have cumulative negative effects on reptile and amphibian populations. Invertebrates are also not active during cold weather and would have few interactions with hunters during the hunting season. Refuge regulations further mitigate possible disturbance by hunters to non-hunted wildlife. Vehicles are restricted to roads and the harassment or taking of any wildlife other than the game species legal for the season is not permitted.

Although ingestion of lead-shot by non-hunted wildlife could be a cumulative impact, it is not relevant to the Refuge because the use of lead shot for waterfowl and alligator hunting is not permitted.

Invertebrates including moths and butterflies occur year round on the Refuge; however, hunter interaction would be commensurate with that of non-consumptive users.

4.3.1.4 Endangered Species

Two federally listed bird species occur on the Refuge – the wood stork and Everglades snail kite. Wood storks are a frequent user of the Refuge during extreme low water

conditions, typically occurring outside of the hunting season. High numbers of wood storks (300) have been observed foraging on the Refuge interior and impoundments when water levels are very low. Occasionally, but infrequently, wood storks will nest and have nested successfully. Two pairs nested successfully in 1990, one unsuccessfully in 1999, 21 successfully in 2009, as examples. Relatively low nesting rates and predominant foraging outside of the current hunting season limit hunter interactions with wood storks.

Everglade snail kite nests have been identified to the north of the proposed hunt area, but are sufficiently outside the area where they could be impacted. Snail kites are highly mobile, moving over large distances as foraging conditions change. Both wood stork and snail kites may frequent the hunting area traveling through or stopping to forage. Hunter interactions with these species are, however, expected to be minimal. A Section 7 Evaluation was conducted in association with this assessment for opening hunting on the Arthur R. Marshall Loxahatchee National Wildlife Refuge. It was determined that the proposed alternative was not likely to adversely affect this threatened species.

4.3.2 Anticipated Direct and Indirect Impacts of Proposed Action on Refuge Programs, Facilities, and Cultural Resources

4.3.2.1 Wildlife-Dependent Recreation

As public use levels expand across time, unanticipated conflicts between user groups may occur. The Refuge's visitor use programs would be adjusted as needed to eliminate or minimize each problem and provide quality wildlife-dependent recreational opportunities. Experience has proven that time and space zoning (e.g., establishment of separate use areas, use periods, and restrictions on the number of users) is an effective tool in eliminating conflicts between user groups.

The level of recreational use and ground-based disturbance from visitors would be largely concentrated at trails and the Refuge's office and maintenance areas. This, combined with the addition of increased hunting opportunity, could have a negative effect on nesting bird populations. However, the hunting season is during the late summer through fall and early winter and not during the nesting period of most birds utilizing the Refuge.

The opportunities for hunting increase, but the hunt boundary (30,000 acres) would remain the same. The Refuge would control access under this alternative to minimize wildlife disturbance and habitat degradation, while allowing current and proposed compatible wildlife-dependent recreation.

4.3.2.2 Refuge Facilities

The Service defines facilities as: "Real property that serves a particular function(s) such as buildings, roads, utilities, water control structures, raceways, etc." Under the proposed action those facilities most utilized by hunters are: parking lots, marsh trails, and boat launching ramps. Maintenance or improvement of existing facilities (i.e. parking areas, marsh trails, and boat ramps) will cause minimal short term impacts to localized soils and waters and may cause some wildlife disturbances and damage to vegetation. The facility

maintenance and improvement activities described are periodically conducted to accommodate daily Refuge management operations and general public uses such as wildlife observation and photography. Marsh trails will not be constructed unless appropriate water quality concerns are addressed. These activities will be conducted at times (seasonal and/or daily) to cause the least amount of disturbance to wildlife. During times when roads are impassible due to weather events or other natural causes, those parking lots, marsh trails, and boat ramps impacted by the event will be closed to vehicular use.

4.3.2.3 Cultural Resources

Hunting, regardless of method or species targeted, is a consumptive activity that does not pose any threat to historic properties on and/or near the Refuge. In fact, hunting meets only one of the two criteria used to identify an “undertaking” that triggers a Federal agency’s need to comply with Section 106 of the National Historic Preservation Act. These criteria, which are delineated in 36 CFR Part 800, state:

- 1) an undertaking is any project, activity, or program that can alter the character or use of an archaeological or historic site located within the “area of potential effect;” and
- 2) the project, activity, or program must also be either funded, sponsored, performed, licenses, or have received assistance from the agency.

Consultation with the pertinent State Historic Preservation Office and Federally recognized Tribes are, therefore, not required.

4.3.2.4 Anticipated Impacts of Proposed Hunt on Refuge Environment and Community

The Refuge expects no sizeable adverse impacts of the proposed action on the Refuge environment which consists of soils, vegetation, air quality, water quality, and solitude. Some disturbance to surface soils and vegetation would occur in areas selected for hunting; however, impacts would be minimal. The Refuge would also control access to minimize habitat degradation.

The Refuge expects impacts to air and water quality to be minimal and only due to Refuge visitors’ vessel emissions. The effect of these Refuge-related activities, as well as other management activities, on overall air and water quality in the region are anticipated to be relatively negligible, compared to the contributions of industrial centers, power plants, and non-Refuge vehicle traffic. Existing State water quality criteria and use classifications are adequate to achieve desired on-Refuge conditions; thus, implementation of the proposed action would not impact adjacent landowners or users beyond the constraints already implemented under existing State standards and laws.

Impacts associated with solitude are expected to be minimal given time and space zone management techniques, such as seasonal access and area closures, used to avoid conflicts among user groups.

The Refuge would work closely with State, Federal, and private partners to minimize impacts to adjacent lands and its associated natural resources; however, no indirect or direct impacts are anticipated. The change in the species hunted to both alligators and waterfowl would result in a net gain of public hunting opportunities positively impacting the general public, nearby residents, and Refuge visitors. The Refuge expects increased visitation and tourism to bring additional revenues to local communities, but not a significant increase in overall revenue in any area.

4.3.2.5 Other Past, Present, Proposed, and Reasonably Foreseeable Hunts and Anticipated Impacts

Cumulative effects on the environment result from incremental effects of a proposed action when these are added to other past, present, and reasonably foreseeable future actions. While cumulative effects may result from individually minor actions, they may, viewed as a whole, become substantial over time. The proposed hunt plan has been designed so as to be sustainable through time given relatively stable conditions. Changes in Refuge conditions, such as sizeable increases in Refuge acreage or public use, are likely to change the anticipated impacts of the current plan and would trigger a new hunt planning and assessment process.

The implementation of any of the proposed actions described in this assessment includes actions relating to the Refuge hunt program (see 2012 Sport Hunting Plan for the Arthur R. Marshall Loxahatchee National Wildlife Refuge). These actions would have both direct and indirect effects. Adding alligators to the current hunt program would result in increased public use, thus increasing vessel traffic and disturbance, but the hunt boundary will remain the same as the waterfowl hunt. Therefore, cumulative effects of these actions are not expected to be substantial.

4.3.2.6 Anticipated Impacts if Individual Hunts are Allowed to Accumulate

National wildlife refuges, including the Arthur R. Marshall Loxahatchee National Wildlife Refuge, conduct hunting programs within the framework of State and Federal regulations. The Refuge is at least as restrictive as the State of Florida. By maintaining hunting regulations that are as, or more, restrictive than the State, individual refuges ensure that they are maintaining seasons which are supportive of management on a more regional basis. The proposed hunt plan has been reviewed and is supported by the FWC. Additionally, refuges coordinate with FWC annually to maintain regulations and programs that are consistent with the State management program.

Chapter 5 Consultation and Coordination with Others

The Florida Fish and Wildlife Conservation Commission concur and fully support the regulated consumptive public use of the natural resources associated with the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The Service also provided an in depth review by the Regional Office (RO) personnel and staff biologists. Numerous contacts were made throughout the area of the Refuge soliciting comments, views, and ideas into the development of the accompanying hunting plan.

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Appendix B Night-Light Surveys Background Information and Justification

The reliability and utility of night-light surveys have been carefully scrutinized during the early years of developing the strategies for managing alligator populations in Florida (Woodward, et al, 1996 and Fujisaki, et al, 2011). There are limitations to the inferences that can be made from the analysis of night-light survey data; however, when used appropriately, night-light surveys serve as an adequate and important safeguard against the overharvest of alligator populations (Woodward, et al, 1996). The term “overharvest” can be interpreted differently, but for the sake of this explanation, it is intended to mean that a population is sent into significant decline due primarily to the harvest of alligators from the population. In other words, agencies do not expect our monitoring efforts (based on night-light surveys) to protect the population from declines that may or may not be the result of harvest. Rather, these monitoring efforts give us the ability to identify declines and make adjustments to harvest levels, including stopping harvests, if populations are unable to sustain such harvests.

To maximize the ability to detect population trends from night-light surveys, agencies have incorporated a variety of strategies and practices in survey techniques and data analyses. The following are some examples:

1. Surveys for a given area are conducted during the same time of year (spring or summer) every year. This ensures that the data being analyzed are comparable in terms of seasonal activity/movement, thus eliminating this form of variation from the analyses.
2. Surveys are replicated each year. Replicates are conducted at least 14 days apart in order to create as much independence between surveys as possible. This has been shown to increase the power of detecting trends.
3. Seventy percent confidence intervals are used to determine significant departures from the desired population level. This allows us to declare that a decline has occurred sooner than we would by using 95% CI. This, combined with survey replications, has been shown to give us approximately 80% power to detect a 10%/year decline over 7 years. A 10%/year decline over 7 years is approximately equivalent to a 50% overall reduction in the population.
4. Water levels are used as a covariate in the trend analysis, thus accounting for this form of variation in the data.

The harvest rates that are applied (based primarily on night-light survey analyses) are based on research and have a long history of success in Florida’s alligator management program. This is not to say that declines have not been seen on harvested areas, because there have been on a small proportion of areas. Whether the observed declines were primarily the result of the harvest program is unknown, as droughts and disease outbreaks can also cause population declines, but the monitoring system allows for an adjustment of quotas or can stop harvests while populations are at levels that can easily recover.

Experience in Florida has shown that alligator populations can recover relatively quickly from depressed levels.

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Appendix C General Methods for Assigning Size Categories and Determining Harvest Quota

Data were accumulated from nightlight surveys such that counts were made in the following length (l) categories in feet: $1 < l$; $1 \leq l < 2$; $2 \leq l < 3$; $3 \leq l < 4$; $4 \leq l < 5$; $5 \leq l < 6$; $6 \leq l < 7$; $7 \leq l < 8$; $8 \leq l < 9$; $9 \leq l < 10$; $10 \leq l < 11$; $11 \leq l < 12$; $12 \leq l < 13$; $13 \leq l$; l unknown; $l \leq 2$; $2 \leq l < 4$; $4 \leq l < 6$; $4 \leq l$; $6 \leq l$; $9 \leq l$; $l \leq 3$; $3 \leq l < 6$. In meters these are: $l < 0.3$; $0.3 \leq l < 0.6$; $0.6 \leq l < 0.9$; $0.9 \leq l < 1.2$; $1.2 \leq l < 1.5$; $1.5 \leq l < 1.8$; $1.8 \leq l < 2.1$; $2.1 \leq l < 2.4$; $2.4 \leq l < 2.7$; $2.7 \leq l < 3$; $3 \leq l < 3.4$; $3.4 \leq l < 3.7$; $3.7 \leq l < 4$; $4 \leq l$; l unknown; $l \leq 0.6$; $0.6 \leq l < 1.2$; $1.2 \leq l < 1.8$; $1.2 \leq l$; $1.8 \leq l$; $2.7 \leq l$; $l \leq 0.9$; $0.9 \leq l < 1.8$.

Water temperature and water level were also recorded at the time of each survey. Surveys were performed on 1- [x] routes with 1-2 replicates within 'y' units (lakes or other water bodies) over 'z' years. The maximum number of routes in a unit is denoted as 'x,' 'y' is the total number of units, and 'z' is the span of years that applies. For trend analysis by year, counts in each size category were summed, and average date, water level, and water temperature were determined within a replicate on a unit for each year. Water levels and temperatures were adjusted to represent differences from the overall means in the units. Zero sum counts were replaced by 1-8. To combine the unit-interval counts (e.g., $1 \leq l < 2$) with multi-unit-interval counts (e.g., $2 \leq l < 4$), Turnbull's (1976) approach for interval censored data was applied via the "%ice" macro of SAS Institute, Inc. (2010; see also So et al., 2010). Paul S. Kubilis (University of Florida, Institute of Food and Agricultural Sciences) modified this macro to produce an overall probability distribution function (PDF) describing the estimated proportions of unit-interval lengths for each replicate-unit-year sample. The PDF was summed for specified portions of the alligator size range to produce the cumulative distribution function (CDF) for each replicate-unit-year. Standard errors and 95% confidence intervals for CDF were determined via the macro as well, and these were multiplied by the total of number of all alligators counted for each replicate-unit-year sample to estimate the total count, standard error, and confidence limits. The portions of the alligator size range for which total counts were estimated in this way were: $l < 4$ ft ($l < 1.2$ m); $3 \leq l < 6$ ft ($0.9 \leq l < 1.8$ m); $6 \leq l < 9$ ft ($1.8 \leq l < 2.7$ m); $4 \leq l < 14$ ft ($1.2 \leq l < 4.3$); $6 \leq l < 14$ ft ($1.8 \leq l < 4.3$ m); $9 \leq l < 14$ ft ($2.7 \leq l < 4.3$ m) and $l < 14$ ft ($l < 4.3$ m).

Year trends in the natural logarithms of the estimated counts were modeled with package 'GAM' (generalized additive modeling; Hastie 2009) of the R statistical environment (R Development Core Team 2009). The R script was based on one originally written for the S-Plus statistical environment by Paul S. Kubilis. For most units, nine models with the following predictors plus intercept were compared by AICc. (1) none besides intercept; (2) linear year effect; (3) linear water level effect; (4) 4 knot spline for year (5) 4 knot spline for water level; (6) linear year and linear water level; (7) linear year and 4 knot spline for water level; (8) linear water level and 4 knot spline for year; (9) 4 knot spline for year and 4 knot spline for water level. Log counts were weighted by (count/count standard error). Thus, these 9 models encompassed constant, linear, semiparametric, and

fully nonparametric additive approaches with year and relative water level as predictors. If the model indicated that there had been >50% decline, then alligator harvest in that unit was ended. If the model indicated a 25-50% decline, then the quota was set to 3%. If the model indicated a change between -25% and +25%, then the quota was set to 6%. If the model indicated a change greater than +25%, then the quota was set to 12%. If the model indicated a change greater than +25% even after 3 years of 12% quota, then the quota was raised to 15%. A greater than 25 percent change above or below the preharvest population estimate will be declared only if bootstrap P-values for tests on the predicted percent change are less than 0.15.

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